United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

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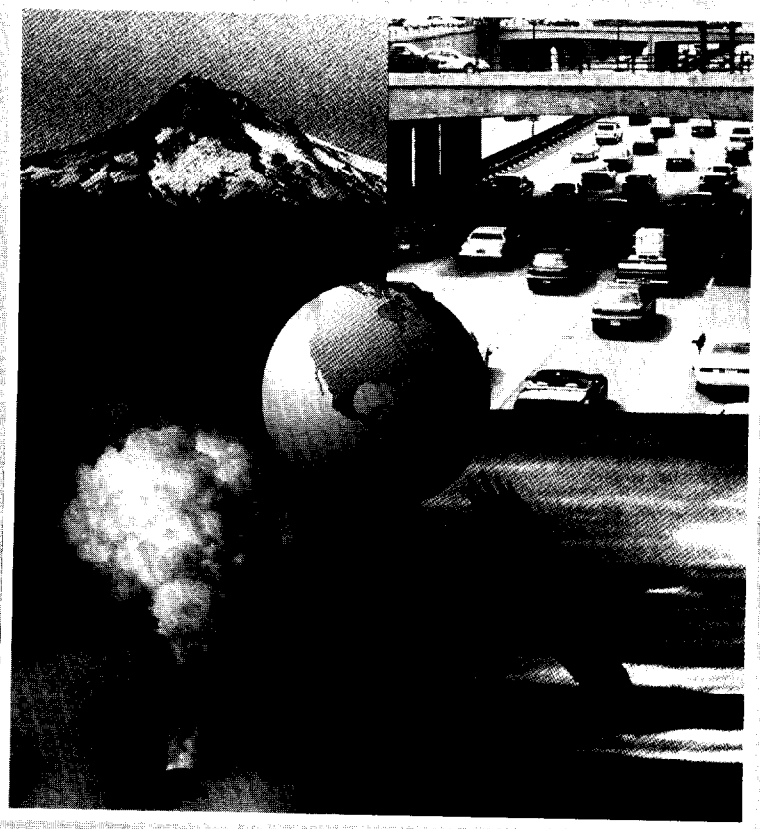
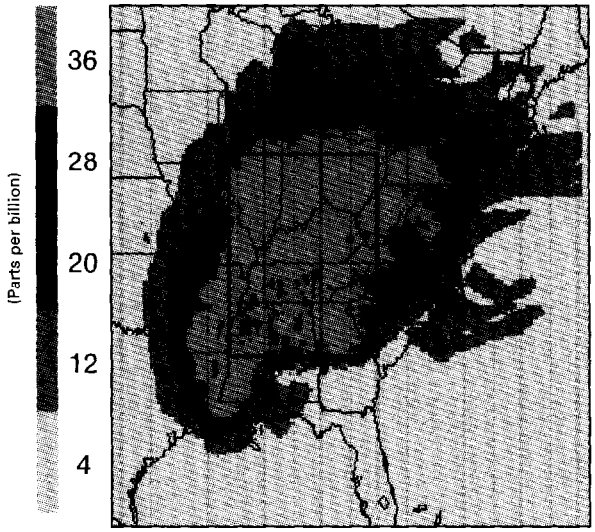
EPA Regional Approaches to Improving Air Quality



AIR POLLUTION CAN BE TRANSPORTED HUNDREDS OF MILES DOWNWIND FROM ITS ORIGIN.



This model of a July 1991 ozone episode shows how far downwind emissions originating from industrial and mobile sources in the boxed area can be transported.

INTRODUCTION

Each individual breathes nearly 13,000 liters (approximately 3,400 gallons) of air every day. Yet the air is being polluted by human activities like driving cars, burning fossil fuels, and manufacturing chemicals, and natural events such as forest fires. These add gases and particles to the air we breathe and, in high enough concentrations, can have harmful effects on people and the environment. Many air pollutants such as those that form urban smog, acid rain, and some toxic compounds remain in the environment for long periods of time and can be transported great distances from their origin.

SINCE AIR POLLUTANTS DO NOT RECOGNIZE POLITICAL BOUNDARIES, STATES AND COMMUNITIES CANNOT INDEPENDENTLY SOLVE ALL OF THEIR AIR POLLUTION PROBLEMS.

The struggle for clean air is almost as old as industrialized society. In 1661, John Evelyn and John Graunt of England each published studies associating negative health effects with industrial air emissions. Both researchers described the transport of pollutants between England and France and suggested protecting human health by locating industrial facilities outside of towns and using taller smokestacks to spread "smoke" into "distant parts."

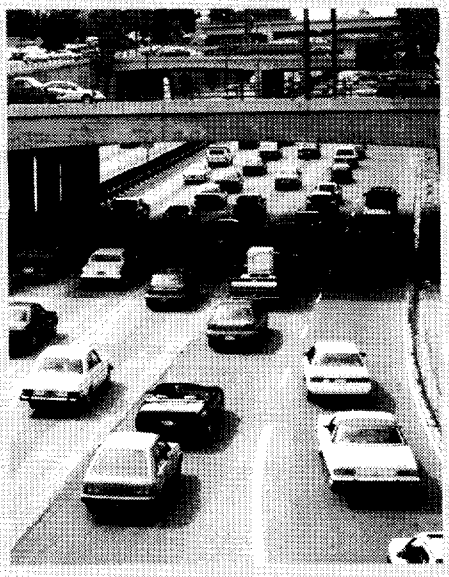
Research continues to show that air pollution can be carried hundreds of miles from its source and can cause health and environmental problems on a regional or even global scale. In people, air pollution can cause burning eyes, irritated throats, difficulty with breathing, long-term damage to the respiratory and reproductive systems, cancer, and, in extreme cases, death. Trees, lakes, crops, buildings, and statues can be damaged by air pollution. Air pollutants also cause haze, impairing visibility in cities, national parks, and other scenic areas.

Under the Clean Air Act, passed by Congress in 1970 and recently amended in 1990, the U.S. Environmental Protection Agency (EPA) sets and enforces air pollutant limits on sources such as power plants and industrial facilities to help protect against harmful health and environmental effects. Although the Clean Air Act is a Federal law, state and local agencies are responsible for implementing many of its requirements.

Specific air pollutants such as sulfur dioxide (SO_2), particulate matter, ground-level ozone, and the emissions that form these pollutants can travel great distances from their sources. Since air pollutants do not recognize political boundaries, states and communities cannot independently solve all of their air pollution problems. Resolving air pollution control issues often requires state and local governments to work together to reduce air emissions. The Clean Air Act established groups such as the Ozone Transport Commission in the northeastern U.S. and the Grand Canyon Visibility Transport Commission in the western U.S. to develop regional strategies to address and control air pollution. Many other such groups have also been formed to address the regional transport of air pollutants.

This brochure describes selected air pollutants of regional concern in the U.S. and summarizes ongoing efforts to control them.

GROUND-LEVEL OZONE



Ozone that occurs naturally in the upper atmosphere surrounding the Earth provides a filter for the damaging ultraviolet light emitted by the Sun. At ground level, ozone is harmful to living things. Ground-level ozone is an air pollutant that damages human health, vegetation, and many common materials. It is a key ingredient of urban smog.

SOURCES

Ground-level ozone is not emitted directly into the air, but rather is formed by gases called oxides of nitrogen (NO_x) and volatile organic compounds (VOC), which in the presence of heat and sunlight, react to form ozone. Ground-level ozone forms readily in the atmosphere, usually during hot weather. As a result, it is known as a "summer-time" air pollutant. Emissions of NO_x are produced primarily when fossil fuels are burned in motor vehicle engines, power plants, and industrial boilers. There are hundreds of thousands of sources of VOC emissions including automobile emissions, gasoline vapors, chemical solvents, and consumer products like paints.

HEALTH & ENVIRONMENTAL EFFECTS

Repeated exposure to ozone pollution for several months may cause permanent structural damage to the lungs. Because ozone pollution usually forms in hot weather, anyone who spends time outdoors in the summer is at risk, particularly children, moderate exercisers, and outdoor workers. Even when inhaled at very low levels, ground-level ozone triggers a variety of health problems including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

Ground-level ozone is also responsible for 1 to 2 billion dollars in reduced crop production in the U.S. each year. Because ground-level ozone interferes with the ability of plants to produce and store food, they are more susceptible to disease, insects, other pollutants, and harsh weather. Ozone also damages the foliage of trees and other plants, ruining the appearance of cities, national parks, and recreation areas.

REGIONAL TRANSPORT

Under the Clean Air Act, EPA has set acceptable levels, called National Ambient Air Quality Standards, for ozone in the air we breathe. Some parts of the U.S. are currently unable to meet these standards. These areas are described as "nonattainment" areas. Tens of millions of Americans live in ozone "nonattainment" areas, primarily in parts of the Northeast, Lake Michigan area, Atlanta, southeastern Texas, and parts of California. Many of these nonattainment areas have focused a great deal of effort on reducing VOC and, in some cases, NO_x emissions from stationary (factories) and mobile (vehicles) sources within their jurisdictions. In several cases, emission controls are not producing the reductions in ground-level concentrations of ozone needed to meet the national health standard.

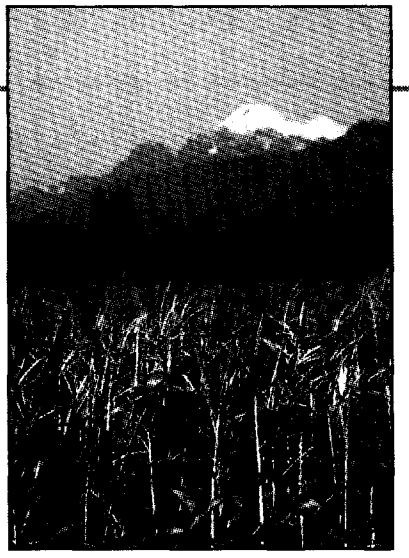
$$VOC + NO_x + Heat + Sunlight = Ozone$$

According to this simplified equation, volatile organic compounds and oxides of nitrogen react, in the presence of heat and sunlight, to form ozone.

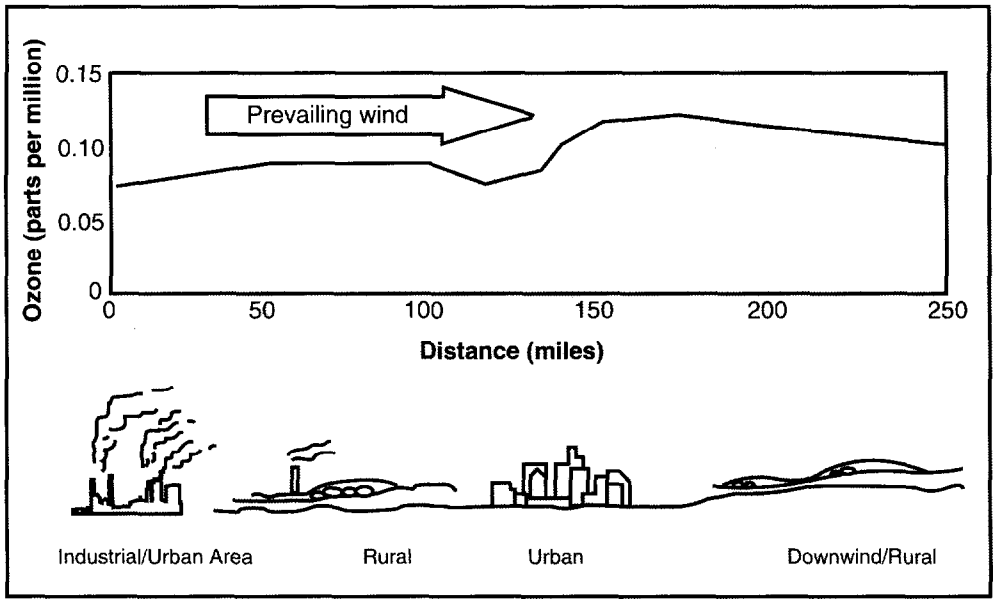
Ozone "precursors," such as NO_x emissions, as well as ozone itself, can be carried hundreds of miles from their origins, causing air pollution over wide regions. Although many urban areas have made efforts to control ozone by reducing local NO_x and VOC emissions, incoming ozone transported from upwind areas also needs to be addressed in order to meet the National Ambient Air Quality Standards. High levels of ozone entering some nonattainment areas can make achieving the national ozone standard difficult and costly, unless upwind sources are identified and controlled. If these sources fall within a certain state's boundaries, it can take measures to control them. If, as is often the case, these sources fall beyond the political boundaries of that state, it must work with EPA and other states to reduce air pollution on a regional scale. Often, it is more cost-effective to reduce emissions from upwind sources than to control emissions from smaller and smaller businesses in the nonattainment areas being affected downwind.

Some regional strategies for reducing ground-level ozone include:

- *reducing NO_x emissions from power plants and industrial combustion sources*
- *introducing low-emission cars and trucks*
- *burning gasoline reformulated to reduce VOC, NO_x, and other emissions.*



GROUND-LEVEL OZONE IS ALSO RESPONSIBLE FOR 1 TO 2 BILLION DOLLARS IN REDUCED CROP PRODUCTION IN THE U.S. EACH YEAR. BECAUSE GROUND-LEVEL OZONE INTERFERES WITH THE ABILITY OF PLANTS TO PRODUCE AND STORE FOOD, THEY ARE MORE SUSCEPTIBLE TO DISEASE, INSECTS, OTHER POLLUTANTS, AND HARSH WEATHER.



Ozone, VOC, and NO_x air emissions from upwind industrial/urban areas contribute to ozone concentrations hundreds of miles downwind in rural and other urban areas. When combined with local air emissions, regionally transported ozone causes some areas to exceed the National Ambient Air Quality Standards (NAAQS) for ozone.

PARTICULATE MATTER

EVIDENCE FROM COMMUNITY STUDIES LINKS PARTICULATE EXPOSURE TO PREMATURE DEATH, INCREASED HOSPITALIZATION, SCHOOL ABSENCE, AND LOST WORK DAYS DUE TO RESPIRATORY AND CARDIOVASCULAR DISEASES LIKE ASTHMA.

Particulate matter, which includes solid particles as well as liquid droplets found in the air, can be described as "haze." Breathing particulate matter can cause serious health problems. Particulates also reduce visibility in many parts of the U.S. They can also accelerate corrosion of metals and damage paints and building materials such as concrete and limestone.

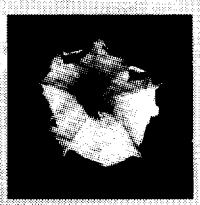
SOURCES

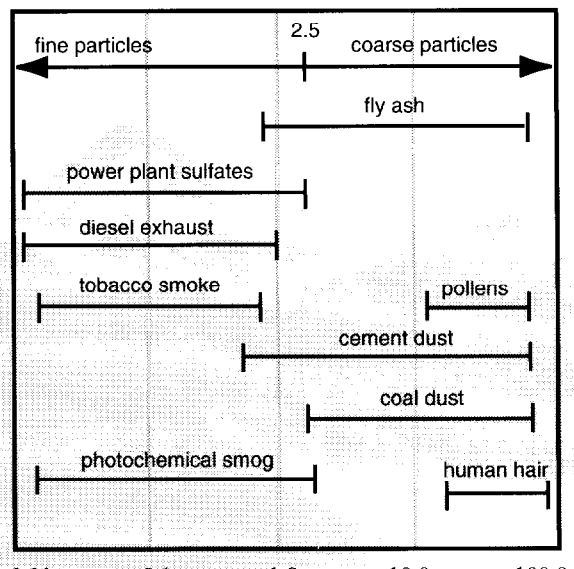
Particulate matter comes from a variety of sources. Some particles are emitted directly from their sources such as smokestacks and cars. In other cases, gases such as sulfur oxide, SO_2, NO_x, and VOC interact with other compounds in the air to form particulate matter. As a result, the chemical and physical composition of particles varies widely. "Coarse" particles are larger than 2.5 micrometers and generally come from sources such as vehicles traveling on unpaved roads, materials handling, crushing and grinding operations such as cement manufacturing, and combustion sources. Particles less than 2.5 micrometers (0.0004 inch) in diameter are known as "fine" particles. Fine particles result from fuel combustion in motor vehicles, power plants and industrial facilities, residential fireplaces, woodstoves, wildfires, and prescribed forest burning. Fine particles can also be formed in the atmosphere from gases such as SO_2, NO_x, and VOC.

HEALTH & ENVIRONMENTAL EFFECTS

Particulate matter less than 10 micrometers in size, including fine particles less than 2.5 micrometers, can penetrate deep into the lungs. On a smoggy day, one can inhale millions of particles in a single breath. Tens of millions of Americans live in areas that exceed the national health standards for particulates. In recent studies, exposure to particulate pollution — either alone or with other air pollutants — has been linked with premature death, difficult breathing, aggravated asthma, increased hospital admissions and emergency room visits, and increased respiratory symptoms in children. People most at risk from exposure to fine particulate matter are children, the elderly, and people with chronic respiratory problems.

Fine particles scatter and absorb light, creating a haze that limits our ability to see distant objects. Some particles, such as sulfates and nitrates, grow in size as humidity





This schematic shows the general size range of selected airborne particles in micrometers. The size range of a human hair is also indicated. (Not drawn to standard scale.)